CHANGING THE FOCUS: Fostering the Development of Science, Technology, and Society Programs in Schools

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Introduction

This paper deals with the challenging, stressful, dynamic, sometimes frustrating, but ultimately rewarding process of educational change. We will specifically address the change in focus from traditional school district-designed, fact-oriented science curricula in which teachers are in charge of designing and implementing instruction to a Science, Technology and Society (STS) plan for science instruction in which students take a more active role in delineating what is discussed in classes based on issues important to them.

Our discussion will draw upon two major resources to help convey the promises and pit-falls inherent in the change process when schools move from a traditional orientation to one which features an STS, issue-based, relevance approach. These two sources are the growing literature base addressing general issues of educational change and the combined experience of a team of inservice workshop designers. (Over the past few years, these team members have assisted several hundred teachers and administrators to make the shift to STS.)

We agree with Goodlad[1] whose study of the nations' schools, found that education improvement efforts require focus on entire schools, not just teachers or principals or curricula or organization or school-community relations. Our experience in the design and implementation of STS educational schemes supports this view. Only by insuring that all those who will be affected by the proposed change understand its theoretical basis and practical application, can any reform effort such as STS be effective. All too frequently one or more of the key players is inadvertently left out of the process. By omitting these individuals, most innovations are almost certainly doomed to fail.

Unlike some STS plans which center on the curriculum alone, the University of Iowa view, supported in the new National Science Teachers Association position on STS education, includes both curriculum and pedagogical components.[2] Issues that tie science with technology and society are to be featured in preference to textbook derived facts alone, but this change in curriculum focus can be enhanced by an accompanying change in teaching style. A major part of the STS development effort is for teachers to adopt a new teaching strategy in which the textbook becomes a resource rather than a plan of study. Teachers must encourage student questions and permit these questions and concerns to become the organizing force for classroom discussion. These changes in curriculum orientation and teaching style represent fundamental departures from the way in which many teachers and school districts presently design and implement educational programs, but these changes are essential if STS is to have maximum effect.

STS and Teachers

The successful implementation of an STS approach in science teaching requires that teachers make several changes. The teacher is perhaps the single most important component of the change process. While students, parents, and administrators need to respond and react differently, it is the teacher who is central to *causing and supporting* the changes in the classroom.

In a broad sense, the teacher must change his/her personal veiws of teaching and learning. The teacher must be able to "step back" and encourage students to take a more active role in the classroom. In an STS

classroom, the teacher must allow stuents the freedom to make decisions about the issues that will be studied, the questions that will be investigated, and the resources that will be contacted.

The changes that take place vary depending upon the philosophy of the individual teacher. The following list contains specific changes which should occur in teachers to best support the move toward STS. These factors are a summary of items identified by hundreds of teachers who have participated in the University of Iowa inservice programs. Individual teachers need to assess where they stand with respect to each of the strategies, and make the appropriate changes.

Change is a gradual process. Teachers are able to develop a plan for implementing changes over time, by evaluating where they stand currently, and identifying where they would ideally like to be. While the strategies listed may serve as goals for most STS teachers, the individual strategies will be accomplished to varying degrees, and at different rates, for each individual teacher.

To facilitate an STS approach the teacher should:

- expect students to identify the issues/topics for investigation
- organize instruction around relevant topics
- foster questioning in their students
- encourage students to seek out answers to their own questions
- encourage students to utilize a wide variety of resources in answering their questions
- evaluate and assess students using an expanded range of instruments
- provide opportunities for students to apply concepts and skills to new situations
- advocate that students take social action where appropriate
- extend science investigations to other areas of the school curriculum and community

What goes on in most traditional classrooms can be compared with a theatrical production. Traditionally, the teacher serves as the director, selecting the script (textbook), determining who will play the various roles and setting the production schedule. The performance lacks creativity and requires little independent thought on the part of the actors (students). In an STS classroom, the teacher is still central to the process, but assumes a different role. This time it is like improvisation theatre, with the director overseeing, but not predetermining, the production. The script is developed by the students, based on their needs and concerns. In the long run, the performance is much more creative, requires a far greater degree of skill, and is considerably more challenging and enjoyable for the actors. It is the director who must believe in the actors enough to give up some of the control and decision making. The teacher is the key to allowing this to happen.

STS and Students

Fullan asks the following question when considering the impact of educational change of students, "what would happen if we treated the students as someone whose opinion mattered in the introduction and implementation of change in school?"[3] This question will be addressed in this section focusing on students as vital constituents of the educational community.

Earlier we stated that change is a process not an event. To understand the impact and significance of STS on a student we need to examine what is asked of students as they are confronted with the expectations inherent in STS programs. For example, consider that most teachers rely primarily on textbooks in science class while science, technology and society programs are, by their very nature, issue-based. Students who are accustomed to learning science in teacher-directed, textbook oriented, classrooms may have some initial problems when entering classes with STS as the approach. If the change to an issue-based approach is to be effectively accomplished, the previous experience and present attitudes of the students must be considered. The change process must include a period of orientation and support for these students with the teacher modeling an inquiry approach while understanding that some students may require more time than others to make the shift to the STS strategy. The goal in STS classrooms is to encourage students to become lifelong learners who are aware of the connections between science class and society at large. We want to take students from passivity to activity, but for this to happen teachers must be facilitators rather than learning directors.

Students in issue-based classrooms should:

- become active learners rather than passive recipients
- take increased responsibility for charting direction of the class
- ask questions which require more than a textbook answer

- look outside the science classroom for answers to questions
- learn to use community resources
- help identify issues of personal and classroom interest
- apply information learned in the classroom to situations in the real world
- become a change agent
- understand the impact of science and technology on the community
- act in a responsible way based upon these new understandings
- understand the importance of being scientifically literate
- continue their personal education beyond formal schooling

The preceding list of goals is ambitious, and not all students will achieve every desired outcome. It should be obvious that the complexity and variety of these goals will require that students think about science class in a very different way; students who have been successful in past science classes may resent the fact that the rules seem to be shifting. Only by acknowledging the fact that students will have to change, and that change is inherently difficult, can we make the successful transition to STS.

STS and Administrators

Schools today are faced with the challenge of restructuring educational programs to meet the needs of all students. History is marked with many attempts to rethink how schools could be more effective; knowledge of these past efforts suggests present questions. How are the current reform efforts different from those of the past? How will the structure of relationships within a school change as these transformations occur? What role will administrators play in orchestrating needed changes in the schools of tomorrow? Research centering on effective schools suggests that one of the key change agents within a school or district are the administrators.

School administrators must realize that there can be no guaranteed recipe for change, because of the "people factor." People do not always conform to a standard and will themselves change during the process of innovation. Administrators and school boards must work together with teachers, student and parents in developing guidelines which support the changes occurring within the school. Perhaps one of the most common errors in judgement made by administrators is

a naive belief that all teachers will immediately adopt every innovation following each inservice workshop. Conflicts, problems and reluctance are inevitable as people pursue goals and make changes over a period of time. Patience and insight are important ingredients the administrator can bring to the receipe of change.

Administrators can either sabotage, ignore, or actively support the process, but must be continually aware that in all instances change is a dynamic operation. If the change to an STS focus is to be successful, administrators must become builders rather than blockers. The following list illustrates some of the changes that should occur in administrations as educational organizations and programs move toward an STS perspective.

Administrators can support STS programs by:

- viewing change in a dynamic and positive light
- being aproachable and open to new ideas
- being goal oriented and focused on finding evidence that illustrates success
- realizing that teachers, faculty members, students and parents are valuable resources in the process of school restructuring
- celebrating the successes and recognizing achievements of those in the school
- recognizing the level of concern regarding the innovation in each staff member
- facilitating change through creative scheduling
- serving as a resource provider for teachers
- allowing teachers time together to brainstorm innovative ideas
- involving teachers in plans for staff development while sharing the vision of change
- providing release time for professional development
- helping teachers work together as members of a team while providing the time for this to occur
- allowing lesson plans to reflect personal teaching styles of individual educators.

Challenges faced by administrators in restructured schools will be different if the improvements are to be anything but supeficial and temporary adjustments. It will be the challenge of tomorrow's administrators to articulate a clear vision maintaining and, in some cases, restoring the public's confidence in our schools.

STS and the Community: Focus on Parents, Universities, and Businesses

If the change toward an STS focus is to be successful, links must be forged between schools themselves and the community at large to foster understanding, cooperation and support. Parents and industry represent the most potent ties to schools because these two constituencies clearly have a vested interest in assuring success in the school environment. Parent want their own children to excel, and industry is interested in a qualified work force.

Parents have voiced some concerns that STS is not science, and to a degree they are correct. STS programs, if properly designed, are not like the fact-oriented, teacher-directed science classes they remember from personal school experiences, but sceintific concepts and principles are communicated to students in an STS environment as well. This potential for mis-understanding must be addressed by schools in communicating to parents why the change is necessary and desirable.

Conscientious parents have long supported their own children as they progress through school and there is no reason to expect that will end. The shift toward classes with a STS emphasis may actually serve to attract more parental involvement since parents can now be both supporters and resources for their children. Warner[4] details some of the ways that school districts have extended beyond typical parent-teacher organizations to increase parental involvement and promote communication between home and school. The list below illustrates some of the ways which we have found to increase parental participation. These factors are particularly important as parents assist their children in the move toward an understanding of the interrelationships between science, technology and society.

Parents can support the STS focus by:

- encouraging their children to question the world around them
- talking with their children about social-scientific issues
- assuring that their children see the connections between real world issues
- consideration of what is discussed in school by sharing an interest in current events and STS problems and issues
- helping to maintain communication between the home and school relative to academic achievement

- advocating a change in traditional grade reporting schemes
- taking their children to the library to investigate current problems of interest
- acting as a in-school resource to discuss issues with the entire class
- taking their children to places of interest such as the local landfill, sewage treatment plant or similar facilities
- furnishing small amounts of incidental financial backing to students and schools for STS-related projects.

The community at large, including colleges, universities and businesses play an equally important role in the STS movement. Partnership is perhaps the best single word to describe the function of the community in supporting science, technology and society programs. As Atkin and Atkin point out, "partnerships, alliances, cooperatives and collaboratives are among the new watchwords on the education policy and innovation scene."[5] The lists below illustrate many of the ways in which higher education and business institutions can support and foster the development of science, technology and society programs.

Colleges and universities can support an STS focus by:

- designing appropriate inservice programs and summer institutes to meet teacher needs
- arranging full-scale program implementation and administration of STS initiatives
- making opportunities for mentorships available between university scientists and students
- developing collaborative research and development programs
- establishing scientist/science teacher partnerships

Business and the corporate community can support an STS focus in local schools by:

- making mentorship opportunities available between corporate scientists and students
- loaning scientists to advise students and/or to each courses
- establishing scientist/science teacher partnerships
- making financial contributions which include both major funding for programs and mini-grants for teacher initiatives
- donating unneeded equipment or facilities to STS programs
- celebrating and publicly acknowledging the success of partnerships

- maintaining an advocacy stance in the community for STS education
- giving political support for specific programs and education in general

Conclusions

Some have likened the educational change process to an ecosystem in which the various parts are intimately intertwined, each affecting all the others. Just as the overall health of an ecosystem is dependent upon all parts functioning in concert, educational change can occur smoothly and successfully only if all participants are considered. Changes forced onto systems and changes which neglect participation of all of the principle parties may be momentarily successful, but the long term prospect for permanent change is bleak. By working together to consider the goals and feelings of all those affected by the transition, a change in focus toward science, technology and society programs can be assured and maintained.

References

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